

Association Between Non-HDL to HDL Cholesterol Ratio (NHHR) and Psoriasis in Adults: A Cross-Sectional Study Using 2009–2014 Data

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Background: Because of its possible significance in metabolic diseases, the non-high-density lipoprotein cholesterol to high-density lipoprotein cholesterol ratio (NHHR) has garnered attention as a novel and trustworthy lipid biomarker. Psoriasis may be linked to metabolic problems and obesity, according to earlier research. Uncertainty surrounds the relationship between NHHR and the onset of psoriasis, though. The primary aim of this investigation was to examine the relationship between NHHR and psoriasis.

Patients and methods: This cross-sectional analysis used data from the National Health and Nutrition Examination Survey (NHANES) conducted between 2009 and 2014. The association between psoriasis and NHHR was examined using multivariate logistic regression, and smoothed curve fitting was done to explore the non-linear relationship. Furthermore, Subgroup and sensitivity studies were performed in order to confirm the robustness of the findings.

Results: Psoriasis and NHHR were shown to be positively correlated in 15,951 adult individuals who were at least 20 years old. Psoriasis risk rose by 7% for each unit increase in NHHR [1.07 (1.01, 1.14)]. Individuals in the highest NHHR tertile were 39% more likely compared to those in the bottom tertile to have psoriasis [1.39 (1.09, 1.78)]. Across subgroups, this favorable connection remained consistent.

Conclusion: Elevated NHHR levels are positively correlated with an upsurge chance of psoriasis in the adult population in the United States. The significance of NHHR as an indication for early psoriasis risk assessment is shown by this study.

Keywords: non-high-density lipoprotein cholesterol to high-density lipoprotein cholesterol ratio, psoriasis, lipids, NHANES, cross-sectional study

Introduction

Around the world, 2–3% of people suffer with psoriasis, a widespread chronic disorder.¹ A typical sign of the illness is scaly or flaky erythema, which affects the entire skin surface as well as the extremities and may cause serious systemic disorders and impairments.² This has a significant physical and psychological impact on the sufferer.

These days, it is believed that psoriasis is linked to several comorbidities, the most significant and prevalent of which is metabolic syndrome.^{3–8} Multiple inquiries have also proven that dyslipidemia may be a risk factor.^{9,10} The connection between psoriasis and the metabolic syndrome has come a long way, but little is known about how it interacts with cholesterol. Numerous studies have shown that patients with psoriasis have reduced levels of HDL and/or increased levels of low-density lipoprotein (LDL), very low-density lipoprotein (VLDL).^{11–13} Some studies have also shown that psoriasis alters HDL composition and cholesterol efflux capacity.^{14,15} Furthermore, it had no discernible correlation between psoriatic arthritis and serum TG, HDL-C, or LDL-C in several observational studies of psoriatic arthritis.^{16,17} There is considerable uncertainty regarding the association between psoriasis and plasma lipids because of indications of publication bias and environmental confounding variables.

Non-high-density lipoprotein cholesterol to high-density lipoprotein cholesterol ratio (NHHR) is a crucial statistic for assessing the lipid status in atherosclerosis.¹⁸ Numerous illnesses, such as depression, infertility, osteoporosis, and kidney stones, have been linked to it.^{19–21} It has a solid track record of accurately identifying insulin resistance and the metabolic syndrome.²²

This study used NHANES data from 2009–2014 to further analyze the association between NHHR and psoriasis and to contribute to the understanding that NHHR is a significant indication for early psoriasis risk assessment.

Methods

Study Population

In this study, we used the NHANES database, which is a cross-sectional survey study of US population data conducted every two years by the NCHS. This database is available for free public access at <https://www.cdc.gov/nchs/nhanes/>. The sample selection flowchart is shown in Figure 1. This study used data from 2009 to 2014, with a total of 30,468 participants. We excluded 10,941 people with missing psoriasis data and 1,823 subjects with missing NHHR (HDL-Cholesterol and total cholesterol). In addition, individuals under the age of 20 were excluded. Finally, 15,951 participants were included.

Variables for Study

Evaluation of NHHR

Based on the participants' cholesterol levels, the NHHR was computed. To calculate the NHHR, the non-HDL-C level was divided by the HDL-C level. To calculate the non-HDL-C level, HDL-C is subtracted from total cholesterol. ($NHHR = \frac{\text{total cholesterol} - \text{HDL-C}}{\text{HDL-C}}$). NHHR was intended to be an exposure variable in our study and served as the independent variable.

Evaluation of Psoriasis

In our research, psoriasis served as the dependent variable. If a participant said “yes” when asked the query, “Have you ever been told by a doctor or other health care professional that you had psoriasis (sore-eye-asis)?” then psoriasis was diagnosed. Psoriasis history information was obtained from participant self-reports and verified by other studies that established the accuracy of self-reported psoriasis histories.²³

Assessment of Covariates

Other known variables that may have an impact on the relationship between the NHHR and psoriasis were included in our study. Age (>20 years old), income to poverty ratio, weight, BMI, triglyceride, LDL- cholesterol, total cholesterol and HDL- cholesterol were continuous variables. Gender, race, education level, smoked at least 100 cigarettes, diabetes, marital status were categorical variables.

Statistical Analysis

A sufficient NHANES sample weight was used for the complicated sampling survey design in the research, and all statistical analyses were carried out in compliance with the guidelines established by the Centers for Disease Control and Prevention (CDC). Continuous variables were represented as mean plus or minus standard deviation in the investigation's baseline table, while categorical data were given as percentages (%). The link between NHHR and psoriasis was examined using logistic regression; the results are shown as an odds ratio (OR) and 95% confidence interval (CI). Three models were used: Model 2 considered age, race, and gender, whereas Model 1 did not adjust for covariates. Lastly, based on Model 2, Model 3 also adjusted for diabetes, smoking at least 100 cigarettes per day, income to poverty ratio, marital status, and education level. After tertile classified NHHR as a categorical variable, we carried out further sensitivity analyses to evaluate the robustness of the data. Our use of smoothed curve fitting makes it easier to see the intrinsic link between psoriasis and NHHR data and to understand trends in the data. Because psoriasis is significantly affected by different gender, race, diabetes, and smoking populations, an interaction test was used in order to test whether the relationship between NHHR and psoriasis was stable in these populations. Statistics were regarded as significant when two-tailed $P < 0.05$.

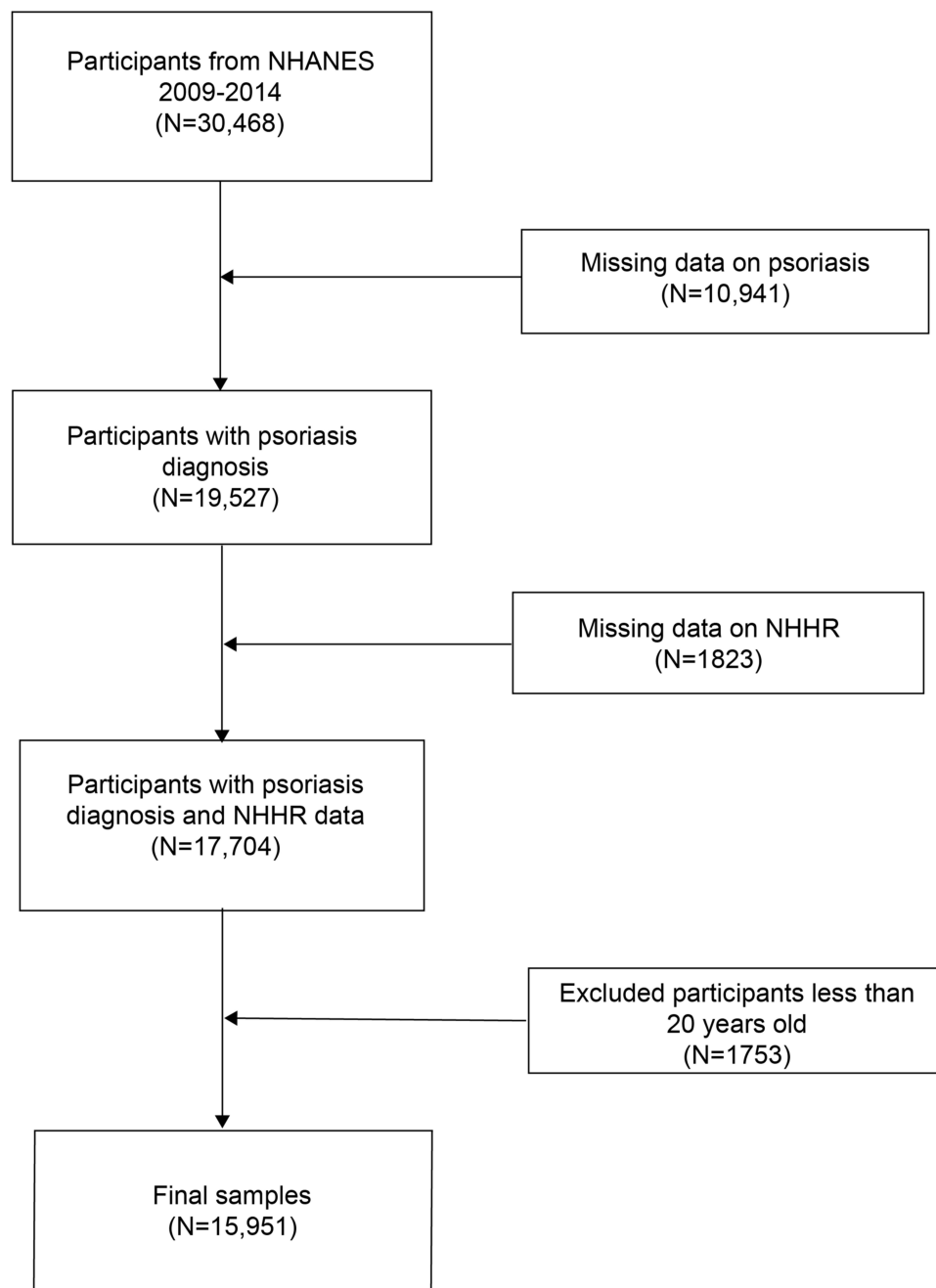


Figure 1 Flowchart of the sample selection from NHANES 2009–2014.

Results

Baseline Attributes of the Participants

This study included 15,951 participants with a mean age of 49.07 ± 17.66 years from the NHANES data (2009–2014). Of them, 51.47% were female and 48.53% were male. Depending on whether or not they had psoriasis, we divided the individuals into two groups.

Table 1 demonstrated that the two teams differed significantly in the fields of age, race, weight, BMI, history of diabetes, smoking status, and NHHR ($P < 0.05$). Those with psoriasis had a significantly higher NHHR (3.07 ± 1.39 vs 2.93 ± 1.40 , $P < 0.05$), and those with psoriasis also tended to be older on average, had a greater number of non-Hispanic white people, weigh more, and have a higher BMI. They also had a greater incidence of diabetes and smoking.

Table I Comparison of Characteristics of Psoriasis Patients and Non-Psoriasis Participants

Characteristics	Non-Psoriasis (N=15499)	Psoriasis (N=452)	P-value
Age, (years)	47.19±16.90	50.51±15.97	<0.0001
Gender, %			0.9973
Male	48.26	48.25	
Female	51.74	51.75	
Race, %			<0.0001
Mexican American	8.67	4.32	
Other Hispanic	5.71	4.51	
Non-Hispanic White	67.07	79.73	
Non-Hispanic Black	11.00	5.21	
Other races	7.52	6.23	
Education level, %			0.5633
Less than high school	16.93	15.14	
High school	21.53	21.48	
More than high school	61.53	63.38	
Income to poverty ratio	2.90±1.61	3.03±1.65	0.0951
Smoked at least 100 cigarettes, %			<0.0001
Yes	43.69	57.12	
No	56.31	42.88	
Marital status, %			0.2037
Married/ Living with partner	63.00	61.01	
Widowed/Divorced/ Separated	18.40	21.57	
Never married	18.60	17.42	
Diabetes, %			0.0015
Yes	9.05	13.59	
Borderline	2.20	2.92	
No	88.75	83.49	
Weight (Kg)	82.32 ± 21.33	84.58 ± 20.38	0.0218
BMI (Kg/m ²)	28.87 ± 6.77	29.71 ± 6.83	0.0071
Triglyceride (mg/dL)	127.10 ± 76.34	126.28±55.07	0.8133
LDL-Cholesterol (mg/dL)	113.88 ± 24.13	114.73±23.96	0.4465
Total Cholesterol (mg/dL)	193.60 ± 41.52	195.39±41.93	0.3506
HDL-Cholesterol (mg/dL)	53.13 ± 16.05	51.79± 16.61	0.0728
NHHR	2.93 ± 1.40	3.07 ± 1.39	0.0362

Abbreviations: HDL-Cholesterol, high-density lipoprotein cholesterol; LDL-Cholesterol, low-density lipoprotein cholesterol; BMI, body mass index; NHHR, non-high-density lipoprotein cholesterol to high-density lipoprotein cholesterol ratio.

Associations Between Psoriasis and NHHR

The connections between NHHR and psoriasis are seen in [Table 2](#). In unadjusted Model 1, each unit in crease in NHHR was associated with an 8% increased risk of psoriasis [1.08 (1.02, 1.14)]. Model 2 [1.08 (1.02, 1.15)] and Model 3 [1.07 (1.01, 1.14)] also showed this relationship. Sensitivity analyses were then carried out with NHHR treated as a categorical variable (tertiles). In Model 3, the likelihood of psoriasis was 39% higher in the highest NHHR tertile (T3) compared to the lowest tertile (T1). [Figure 2](#) shows the smoothed curve fit, further supporting the positive relationship between NHHR and psoriasis.

Table 2 The Association Between Psoriasis and NHHR

	Crude Model (Model 1)	Minimally Adjusted Model (Model 2)	Fully Adjusted Model (Model 3)
	OR(95% CI), P-value	OR(95% CI), P-value	OR(95% CI), P-value
Continuous Categories	1.08 (1.02, 1.14), 0.0109	1.08 (1.02, 1.15), 0.0112	1.07 (1.01, 1.14), 0.0280
Tertile 1	Reference	Reference	Reference
Tertile 2	1.27 (1.00, 1.62), 0.0472	1.28 (1.01, 1.63), 0.0447	1.29 (1.01, 1.64), 0.0398
Tertile 3	1.39 (1.10, 1.76), 0.0059	1.41 (1.11, 1.80), 0.0049	1.39 (1.09, 1.78), 0.0074
P for trend	1.13 (1.03, 1.24), 0.0082	1.14 (1.04, 1.26), 0.0068	1.13 (1.03, 1.25), 0.0109

Notes: The non-high-density lipoprotein cholesterol to high-density lipoprotein cholesterol ratio was converted from a continuous variable to a categorical variable (tertiles). Model 1: No covariates were adjusted. Model 2: Adjusted for gender, age, and race. Model 3: Adjusted for gender, age, race, education level, marital status, income to poverty ratio, smoked at least 100 cigarettes, diabetes.

Abbreviations: OR, Odds ratio; 95% CI, 95% confidence interval.

Subgroup Examination

The stability of the relationship between psoriasis and NHHR across populations was evaluated through subgroup analyses; the results, as presented in Table 3, indicated that effect sizes were consistent across subgroups, with no significant differences by smoking status, gender, ethnicity, or diabetes history. Psoriasis and NHHR have a favorable correlation that remained constant across subgroups and was unaffected by smoking status, gender, race, or diabetes history.

Discussion

This nationally representative cross-sectional study included 15,951 participants to assess the relationship between NHHR and psoriasis. The connection between NHHR and psoriasis in adult US subjects was shown to be positive. Psoriasis and NHHR were shown to be correlated, even after controlling for variables. For every unit rise in NHHR, the prevalence of psoriasis increased by 7% [1.07 (1.01, 1.14)]. Across subgroups based on race, diabetes, smoking status, and sex, this association remained constant. According to the findings, NHHR is crucial for the early diagnosis of psoriasis in people who are at high risk.

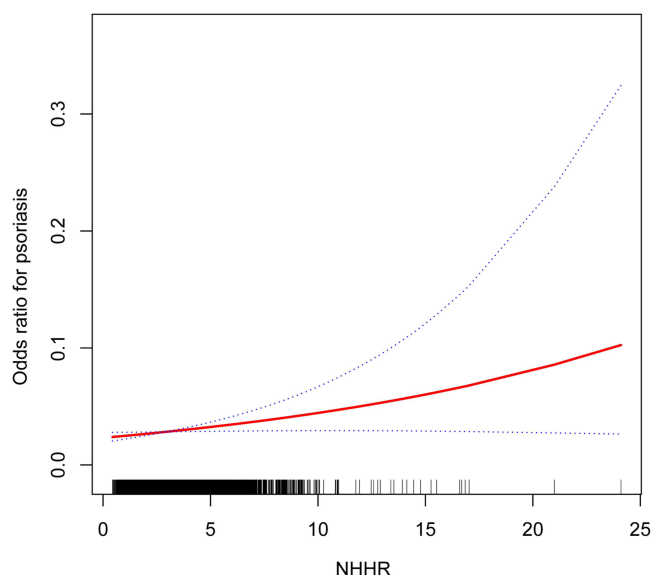


Figure 2 Detected Smooth Curve Fitting With the use of the generalized additive model, a positive connection between NHHR and psoriasis was found.

Table 3 Subgroup Analysis for the Association Between NHHR and Psoriasis

Subgroup	OR(95% CI)	P	P for Interaction
Gender			0.7381
Male	1.08(1.00,1.17)	0.0588	
Female	1.06(0.96,1.16)	0.2598	
Race			0.5197
Mexican American	1.19(0.99,1.43)	0.0571	
Other Hispanic	1.15(0.95,1.40)	0.1460	
Non-Hispanic White	1.03(0.95,1.11)	0.4718	
Non-Hispanic Black	1.13(0.92,1.40)	0.2427	
Other race	1.12(0.93,1.36)	0.2450	
Diabetes			0.0835
Yes	1.02(0.88,1.18)	0.8121	
No	1.10(1.03,1.18)	0.0033	
Borderline	0.69(0.42,1.15)	0.1539	
Smoked at least 100 cigarettes			0.8041
Yes	1.06(0.99,1.15)	0.0902	
No	1.08(0.98,1.20)	0.1363	

Psoriasis is a systemic illness that has been associated with metabolic syndrome and a higher danger of cardiovascular disease.^{24–27} Various investigations have shown that, globally, people with psoriasis have a greater frequency of metabolic syndrome than people without the condition.^{28,29} Additionally, patients with psoriasis have been shown to have a number of altered lipid profiles, the most common of which being elevated serum concentrations of TC, LDL-C, and TG.^{27,30} Dyslipidaemia is the most common risk factor for cardiovascular morbidity. With its data on non-HDL vs HDL cholesterol, the NHHR is a valuable tool for assessing coronary heart disease.¹⁸

The mechanism between NHHR and psoriasis is unclear. According to some research, oxidative stress and low HDL levels are positively correlated,³¹ and oxidative stress elevation is connected to dyslipidemia of LDL.³² It has also been suggested that oxidative stress conditions might lead to the development of psoriasis.^{33–35} Furthermore, an investigation revealed that psoriasis patients had low amounts of lipocalin,³⁶ which increases HDL by improving the breakdown of triglyceride-rich lipoproteins.³⁷ As a result, psoriasis patients frequently experience hyperlipidemia with low HDL levels. Moreover, serum lipocalin levels and TNF- α and IL-6 levels are negatively correlated,³⁸ that is, a drop in human lipocalin levels is associated with an increase in TNF- α and IL-6, which in turn raises the risk of psoriasis. Also, pro-inflammatory cells are linked to hyperlipidemia, diabetes mellitus, hypertension, and other illnesses. TH17 cells are known to generate many cytokines, such as IL-17, TNF- α , and IL-22,³⁹ which can induce excessive proliferation and differentiation of keratinocytes.^{40,41} TH17 cells thus contribute significantly to the onset of psoriasis. Mehta found a more atherogenic lipoprotein profile and decreased HDL efflux capacity in 112 psoriasis patients when compared to controls.¹⁵ HDL isolated from 15 psoriatic patients revealed significant differences in the HDL-associated proteins.⁴² According to a large meta-analysis, psoriasis patients have been shown to have considerably higher levels of both VLDL and LDL.⁴³

Strong clinical significance exists for the study's findings, especially when it comes to patient care and illness prevention. The study's identification of the relationship between NHHR and psoriasis offers clinicians a potential biomarker for identifying at-risk patients in the clinic and putting targeted preventative measures in place. Recognising that the NHHR is a predictive indicator, a proactive two-step approach to routine lipid screening is recommended: identification of potential psoriasis risk through abnormal NHHR levels and comprehensive skin health assessment. It also increases the frequency of monitoring these patients by routinely checking their skin conditions and lipid levels, which may result in the detection and intervention of problems early on. It is also advised that while managing patients with psoriasis, the connection between lipid metabolism and the condition be taken into account. These factors are especially crucial in avoiding the onset of psoriasis and lowering recurrence rates, which enhances patients' quality of life.

This study is the first to evaluate the relationship between the NHHR and psoriasis using the extensive and comprehensive NHANES database, which is nationally representative. The robustness and interpretability of this study are further improved by accounting for potential influencing factors. Nevertheless, there are some limitations of this study: first, although the diagnosis of psoriasis comes from a medical professional or health care practitioner, reliance on self-reported psoriasis conditions can lead to reporting bias and lack of clinical validation. In addition to this, the small sample size of patients diagnosed with psoriasis may lead to biased results; second, because this study was cross-sectional, it was impossible to establish with accuracy the cause-and-effect link between psoriasis and the NHHR. Third, certain factors could still affect the study's findings even after taking possible confounders into account. For instance, the daily medication and lifestyle choices of the individuals. Owing to these drawbacks, it is imperative that further research be done in order to clarify the connection between NHHR and psoriasis and to aid in the creation of more efficient preventative and treatment plans.

Conclusions

The results indicate the 7% jump in risk per unit increase in NHHR, suggesting a connection between an elevated NHHR and a higher chance of developing psoriasis. However, longitudinal studies are still needed to validate the reliability and validity of the NHHR as a predictive biomarker, thus providing a solid scientific basis for psoriasis treatment and prevention.

Abbreviations

BMI, Body mass index; NCHS, National Center for Health Statistics; NHANES, National Health and Nutrition Examination Survey; NHHR, Non-high-density lipoprotein cholesterol to high-density lipoprotein cholesterol ratio; HDL-C, High-density lipoprotein cholesterol; Non-HDL-C, Non-high-density lipoprotein cholesterol.

Data Sharing Statement

Publicly available datasets were examined for this investigation. The information is available at <https://www.cdc.gov/nchs/nhanes/>.

Ethics Statement

According to item 1 and 2 of Article 32 of “the Measures for Ethical Review of Life Science and Medical Research Involving Human Subjects”, this study is exempt from ethical review and approval.

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Author Contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas; took part in drafting, revising or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

Disclosure

The authors state that there were no financial or commercial connections that would have given rise to a conflict of interest in relation to the study.

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